5-2009

Is breakfast or breakfast skipping associated with adiposity in adults? Methodological considerations

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Is Breakfast or Breakfast Skipping Associated with Adiposity in Adults? Methodological Considerations

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Objectives: Our aims were to describe morning eating habits and to determine whether different definitions for breakfast were independently related to adiposity and eating styles.

Design: Cross-sectional data from previous studies on diet and obesity in our lab were used. Dietary intake and waking time was assessed by 3 unscheduled multiple-pass 24-hour recalls. Subjects whose 3-day average energy intake was not within ± 25% of predicted energy requirements were excluded from this analysis. Breakfast was defined in 3 ways: 1) self-defined by subject; 2) the first eating occasion after waking; and 3) the largest eating occasion before 11am.

Subjects: Subjects (n=31; 24 F/ 7 M; aged 22-49 years old), represented BMI ranging from 20-34 kg/m^2.

Results: There were no significant differences among the 3 breakfast definitions in breakfast energy intake (BEI), EI not at breakfast, or the time interval between waking and eating. Controlling for age, sex, and physical activity one of the breakfast variables were associated with adiposity (BMI or percent body fat). When breakfast was defined as the first eating occasion after waking, BEI and the time interval between waking and eating had the strongest associations with eating behaviors and patterns. Eating sooner after waking was associated with higher dietary restraint (r= -0.57), and lower snacking/total eating frequencies (r= -0.32/-0.41), but also a higher intake of food away from home (r=0.46) (all $p<0.10$-<0.05). A higher BEI was also associated with lower total eating frequency (r=-0.36) but had n association with EI not at breakfast.

Conclusion: Despite the inability to detect differences among breakfast definitions, the significant associations found when breakfast was defined as the first eating occasion after waking support this definition as potentially influencing individual eating styles. However, because breakfast was not associated with adiposity, we propose that consuming breakfast earlier in the day may shift the pattern of daily food intake but not total daily energy intake.

Introduction

Obesity and overweight are health concerns for a majority of American adults. Several studies have been conducted on eating patterns associated with the development and prevention of obesity. Breakfast is one meal suggested to be an important dietary factor for energy regulation. Most studies examining this issue in non-dieting adults have been observational and have shown that higher BMI is associated with breakfast skipping and/or a breakfast composition low in fiber or whole grains (Bazzano et al, 2005, Keski-Rahkonen et al, 2003, Song et al, 2005, van der Heijden et al, 2007). Lending some support to this suggestion were the results of a short-term (two 14-d intervention phases) randomized cross-over study conducted by Farshchi et al (2005). In that study, reported daily energy intake (EI) between a breakfast skipping phase (defined as first meal at 10:30-11 am, second at 12:00-1:30 pm) and a breakfast eating phase (defined as first meal at 8:00 am and next at 10:30-11 am) was significantly greater in the breakfast skipping phase compared to the breakfast eating phase. Although statistically significant, the results of that study should be interpreted with caution for several reasons. First, the mean difference was very small at only 50 kcal/d; in addition, there were no differences between phases in weight change or appetite ratings (hunger, satiety, fullness, and prospective food consumption). Also, in both intervention phases, EI appears to have been underreported by approximately 200-250 kcal/d. Thus, we are unable to discern the extent to which breakfast plays an important role in energy regulation from this study alone. To our knowledge, there are no other experimental studies on the effects of skipping breakfast on daily EI or adiposity in subjects who are not intentionally restricting EI.

There are also numerous methodological issues that need to be addressed. First is the lack of a standard breakfast definition. Several studies failed to identify what breakfast is, and definitions varied from being considered the first meal of the day to a morning meal at home

(**Table 1**). And if breakfast *is* defined as a morning meal, what if there is more than one morning eating occasion – are both of two morning eating occasions interpreted as breakfasts or just one? If just one, which one? The first, or the largest? Both definitions have been used in previous studies. Second, there is no clear understanding of what skipping breakfast means. Is it based on a time frame since waking (eg within 2 hours), or a general time of day (eg before work, or some time during the morning)? How long one can wait to eat a meal after waking in the morning for the meal to be considered breakfast? The authors of a recent study in children also recognized that the lack of a standard definition of breakfast skipping could be partially responsible for variation in study results(Kant AK et al, 2008). Another problem, as cautioned above, is that EI is commonly underreported. In an unpublished analysis conducted by McCrory and coworkers (in prep) of eating patterns associated with BMI in study participants plausibly reporting EI vs the total sample, EI underreporting was specific to breakfast and snacking eating occasions, whereas lunch and dinner were not underreported. Furthermore, breakfast skipping or breakfast composition was not associated with BMI when analysis was limited to plausible (McCrory et al, in prep.)

In this proposed study, we examined the impact of some of the methodological issues described above in order to help increase our understanding of the role of breakfast in energy regulation. We aimed to describe morning eating habits as self reported by subjects versus different methods for standardizing the definition of breakfast. In addition, we wanted to determine whether breakfast or breakfast skipping defined in various ways described in our previous aim are related to adiposity measures and whether there is a threshold level of time between waking and consuming food beyond which breakfast skipping and BMI are associated. We hypothesized that habitually having no morning meal is associated with greater adiposity and that longer periods of time between waking and eating in the morning are associated with a greater adiposity.

Methods

We used cross-sectional data from previous studies conducted in Dr. McCrory's laboratory (n~31). BMI was calculated from measured height and fasting body weight, percentage body fat was measured by air displacement plethysmography, and waist circumference was used as indicators of adiposity. Dietary intake was assessed from three unscheduled multiple-pass 24 hour recalls from one weekend day and two weekdays; the first was done in person and the other two by telephone. Nutrient intake was calculated using Food Processor Software (ESHA Research Inc. version 9.8-10.1 Salem, OR). Time of waking was usually recorded in conjunction with the 24-hour recalls, but when that information was missing from the multiple-pass 24 hour recalls (approximately 1/3 of subjects) we retrieved waking time from another questionnaire interview that was administered to subjects on the same day (7-day Physical Activity Recall). In order to determine the validity of this approach, we cross-referenced waking time from the 24-h recall with that from the 7-day PAR in 30 subjects determined at random for whom the waking time was recorded on both interview questionnaires. Reported waking time differed by more than 30 minutes for the majority of this validation sample; therefore, we exclude these subjects from the main analysis.

Statistical Analysis

Basic descriptive statistics were calculated. Analysis of breakfast patterns in relation to adiposity measures performed include correlations and regression analysis. In regression analysis, we controlled for confounding variables including age, sex, and physical activity. When waist circumference was the outcome, we also controlled for BMI. A p-value of 0.05 or less was considered statistically significant. Analyses were performed on the subset of plausible EI reporters. A plausible EI reporter was defined as having a 3-day average reported EI within +/- 25% of predicted energy requirements according to methodology developed and published by Dr. McCrory (Huang et al, 2005).

Results

We found no significant differences among the three breakfast definitions, based off previous studies definitions (**Table 1**), in breakfast EI, EI not at breakfast, or the time interval between waking and eating breakfast (**Table 3**) in our subjects (**Table 2)**. Subjects ranged in age from 22 to 49 with a mean age of 37.5 ± 8.5. Every BMI category was represented, but the mean BMI was 25.4 ± 3.7 kg/m^2 and percent body fat was 31.4 ± 1.5.

When breakfast was defined as the largest eating occasion before 11:00 am, women consumed significantly more energy at breakfast but less energy not at breakfast compared to men. When defined as first eating occasion after waking, overweight individuals ate significantly less than normal weight subjects not at breakfast, but this was disregarded due to low numbers of overweight and obese men (n = 1). There were no significant differences among the groups in the time interval between waking and eating breakfast or other eating patterns.

When examining associations of breakfast variables with other variables (controlled for confounders; **Table 4**), there were no significant associations with either adiposity (BMI or body fat %) or EI not at breakfast, regardless of how breakfast was defined. In addition, examination of scatterplots (not shown) of the time interval between waking and eating in relation to adiposity showed no evidence of any threshold effect.

Among the three definitions, breakfast defined as the first eating occasion of the day had the strongest association with eating behaviors and patterns, whereas breakfast defined in the other two ways had weaker or no associations with those variables. Multiple regression analysis yielded similar results (not shown). All breakfast definitions were positively correlated with increased dietary restraint and the mean restrain as seen in Table 2 for all subjects was 8.0 ± 3.1. Defining breakfast as the first eating occasion of the day after waking showed the strongest correlation.

Discussion

In this analysis, we examined the associations of breakfast variables when defined in different ways with different methodological problems. Breakfast was defined as being self defined by subject, the first eating occasion after waking, and the largest eating occasion (kcals) after waking before 11am. Our results showed no association with either BMI or percent body fat and breakfast. There were no significant differences among the 3 breakfast definitions in breakfast energy intake (BEI), EI not at breakfast, or the time interval between waking and eating, but when breakfast was defined as the first eating occasion after waking, BEI and he time interval between waking and eating had the strongest associations with eating behaviors and patterns. Eating sooner after waking was associated with higher dietary restraint and lower snacking/total eating frequencies but also a higher intake of food away from home. We found no associations between adiposity and any of our breakfast variables in contrast with most (Amosa et al, 2001, Bazzano et al, 2005, Berg et al, 2009, Keski-Rahkonen et al, 2003, Song et al, 2005, Summerbell et al, 1996, van der Heijden et al, 2007), but not all (McCrory et al, in prep).

The energy intake at breakfast showed no significance differences between each BMI category across all three definitions, but normal weight women tended to consume fewer calories at breakfast than overweight and obese women. As previously mentioned, we cannot make inferences about men due to low numbers of overweight and obese male subjects. The energy consumed not at breakfast was similar for the two BMI categories in women, but the normal weight group had a higher rest of the day energy intake. This suggests that EI for the entire day would be similar for both BMI categories of women. The time interval between waking and eating breakfast fluctuated among breakfast definitions, gender, and BMI category. Normal weight women tended to eat breakfast earlier than overweight and obese women

regardless of definition. When comparing time intervals among different definitions within each BMI category normal weight women tended to wait the same amount of time to eat when breakfast was self defined or defined as the first eating occasion after waking. In the overweight and obese BMI category, breakfast self defined or defined as the largest eating occasion before waking had very similar time intervals between waking and sleeping.

When breakfast was defined as the first eating occasion after waking, we found the strongest correlation with different eating patters as well as dietary restraint. Those who consumed more energy at breakfast tended to snack less often, but consumed more energy from food obtained outside the home. This could explain why adiposity was not associated with any definition of breakfast we examined. Typically we would presume less snacking and total eating frequency would equate to a lower EI, but if the subjects are eating more calorie dense meals away from home EI would not be altered and BMI would not be affected. One study found that increased fast food consumption was related to decreased breakfast consumption (Niemeier et al, 2006). Some found increased meal frequency was associated with obesity because snackers had an increased energy intake, but these subjects also ate the majority of their energy later in the day (Forslund et al, 2002). On the other hand, Berg and others found that women who ate more meals outside the home were less likely to be obese than women who did not. Ma and others reported that skipping breakfast was associated with a greater adiposity, but they also found this to be true for those eating breakfast or dinner outside of the time (Ma et al, 2003). We found no associations between our breakfast definition and adiposity, but since we found increased calories away from home when breakfast was defined as the first eating occasion after waking we need to question if it is a worse pattern to skip breakfast or to eat breakfast sooner after waking but then consume more calories away from home.

Dietary restraint is defined as conscious thoughts and purposeful behaviors to control calorie intake (Levine et al, 2008) and in previous studies has been associated with weight maintenance. All breakfast definitions were significantly, positively associated with having restraint. Results may suggest that those with restraint may believe consuming breakfast earlier is a healthy behavior. Amosa and others found that eating breakfast aided in snacking reduction, which could affect adiposity levels. In an intervention study, they found subjects maintaining their weight as opposed to gaining weight had significantly larger increases in restraint than women who gained weight (Levine et al, 2008).

Limitations of this study include the relatively small number of subjects, and the fact that we did not examine the potential influence of breakfast macronutrient and fiber distributions or differentiate between liquid breakfasts and solid foods (non energy containing beverages were excluded from this study). Additionally, there is a possibility of error with our study due to the imperfections associated with human memory in the multiple-pass 24 hour recalls. We were able to avoid this for waking times by comparing 24-hour recall and 7-Day PAR questionnaires. Our information was also derived from cross-sectional data; thus any casual roles for eating patterns will not be ascertained from this study.

Despite the inability to detect differences among breakfast definitions, the significant associations found when breakfast was defined as the first eating occasion after waking support this definition as potentially influencing individual eating styles. However, because breakfast was not associated with adiposity, we propose consuming breakfast earlier in the day may shift the pattern of daily food intake but not total daily energy intake.

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Tables

Table 1. Breakfast definitions in observational studies of breakfast and obesity in adults

Studies	Breakfast Definition
Howden, et al. (1993) (Review)	Consumption of ≥100 kcal 2-3 h after waking
Ortega, et al. (1996)	Consumption before 11 AM
Summerbell, et al. (1996)	Self defined by subject but must provide energy
Haines, et al. (1996)	Consumption between 5 and 9 AM
Nicklas, et al. (1998)	≥ macronutrient value of 1 serving of milk.
Siega-Riz, et al. (2000)	Self defined by subject.
Amosa, et al. (2001)	Self defined by subject
Forslund, et al. (2002)	Subject selects light meal/breakfast option on questionnaire with examples provided of meal type
Keski-Rankonen, et al. (2002)	Eating something before going to school or work
Ma, et al. (2003)	Self defined by subject
Cho, et al. (2003)	Self defined by subject
Song, et al. (2005)	Self defined by subject
Kant, et al. (2006)	Self defined by subject
Howarth, et al. (2007)	Self defined by subject
Kant, et al. (2008)	Self defined by subject
Berg, et al. (2009)	Defined by common expressions and the order of appearance

Table 2: Subject Characteristics (n = 31; 24 women, 7 men)

	Mean ± Standard Deviation	Minimum - Maximum
Age (y)	37.5 ± 8.5	22.0 – 49.0
BMI (kg/m2)	25.4 ± 3.7	20.2 – 33.9
% Body fat (% weight)	31.4 ± 1.5	13.2 -44.4
Physical Activity Level (PAL)	1.5 ± 0.2	1.3 – 2.1
Restraint	8.0 ± 3.1	2.0 – 14.0
Disinhibition	7.0 ± 3.3	1.0 – 12.0
Hunger	5.4 ± 3.9	0.0 – 14.0

Abbreviations: BMI (Body Mass Index)

Table 3: Breakfast variables and other eating patterns by sex and weight status[1]

	Women		Men	
	Normal Weight (n=11)	Overweight (n=13)	Normal Weight (n=6)	Overweight (n=1)
Breakfast EI (kcal/d)				
Self defined	325 ± 43	444 ± 40	406 ± 58	157 ± 143
1st after waking	310 ± 50	386 ± 47	332 ± 68	113 ± 168
Largest before 11 am	369 ± 40	436 ± 37	358 ± 54	113 ± 132
EI not at breakfast (kcal/d)				
Self defined	1645 ± 115	1546 ± 106	2253 ± 156	1951 ± 381
1st after waking	1643 ± 119	1603 ± 110	2226 ± 162	1942 ± 385
Largest before 11 am	1595 ± 116	1570 ± 107	2220 ± 157	1942 ± 385
Time interval between waking and eating breakfast (min)				
Self defined	68 ± 19	109 ± 18	126 ± 28	75 ± 63
1st after waking	69 ± 18	89 ± 16	73 ±26	80 ± 57
Largest before 11 am	82 ± 17	110 ± 16	101 ± 25	80 ± 57
Snacking frequency (no./d)	2.4 ± 0.3	2.5 ± 0.3	2.6 ± 0.4	1.0 ± 0.9
Total eating frequency (no./d)	5.2 ± 0.3	5.2 ± 0.3	5.5 ± 0.4	4.0 ± 0.9
Food away from home (kcal/d)	581 ± 162	774 ± 149	697 ± 219	920 ± 538

1Values are Mean+/-SEM;2 Normal weight: BMI <25 kg/m 2 ; Overweight: BMI ≥ 25 kg/m 2 ; Difference by a a sex (p≤0.05), b weight status (p= 0.054), or c sex x weight status interaction (p = 0.051)

Table 4: Partial correlations for associations of breakfast variables with eating behaviors and patterns by breakfast definition 1

	Self defined		1st after waking		Largest before 11 am	
	EI (kcal/day)	Time interval between waking and eating (min)	EI (kcal/day)	Time interval between waking and eating (min)	EI (kcal/day)	Time interval between waking and eating (min)
BMI	--	--	--	--	--	--
Body Fat % (% weight)	--	--	--	--	--	--
Restraint	--	-0.54***	--	-0.57***	--	-0.44**
Disinhibition	--	--	--	--	--	--
Hunger	--	--	0.43**	--	--	--
Snacking Frequency (no./d)	--	--	-0.38**	-0.32*	--	--
Total Eating Frequency (no./d)	--	--	0.60*	-0.41**	--	--
Food away from home (kcal/d)	--	0.33*	--	0.46**	--	--
EI after breakfast (kcal/day)	--	--	--	--	--	--

Abbreviations: BMI (body mass index); -- (P>0.10)

[1]Values are controlled for age, sex, and physical activity ; *p ≤0.10 **p≤0.05 ***p≤0.01